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Searching for soft leptons in compressed spectra with a Boosted Decision Tree

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Collider searches for electroweak final states from decays involving narrow mass gaps in a new physics sector are kinematically limited by softness of the scattering products. In a prior study, we required a hard initial state jet in order to boost the visible system, and exploited variations in angular separations to suppress topologically identical backgrounds from WW+jets. Presently, we revisit that analysis to establish how much improvement may be realized by the application of machine learning techniques. We provide a boosted decision tree (BDT) with a combination of high-level (e.g. ditau invariant mass, MT2, cos-theta-star), and low-level (e.g. angular separations, PT ratios) variables. We find that the BDT functions most efficiently if "obvious"event selections (e.g. MET, dilepton Z-window) are applied at the outset, and if individual trainings against similar backgrounds are merged into a composite classification score. This approach yields significantly stronger background suppression and signal retention than could be achieved with manual optimization of cuts.

Summary

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